Electronic Version
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Claims

[c1] What is claimed is:

1.A switching alternator system comprising:

a plurality of windings configured to deliver an AC power;

a plurality of switches configured to switch an electrical configuration of the plurality of windings; and

at least one processor programmed to control the plurality of switches to deliver a desired DC power.

[c2] 2.The system of claim 1 wherein the plurality of switches are configured to be switched to at least one of a series configuration, a parallel configuration, and a combination series and parallel configuration.

[c3] 3.The system of claim 1 wherein the at least one processor is programmed to control the plurality of switches to switch the electrical configuration of the plurality of windings upon receiving an interrupt indicative of an engine operation transition.

[c4] 4.The system of claim 3 wherein the interrupt is at least one of a zero-cross interrupt and a voltage regulate interrupt.

[c5] 5.The system of claim 4 wherein the voltage regulate interrupt is disabled if a phase of the AC power is within fifteen degrees of a previous zero-crossing.

[c6] 6.The system of claim 4 wherein the voltage regulate interrupt causes the at least one processor to maintain at least 55 volts on a DC rail.

[c7] 7.The system of claim 4 further comprising a zero-cross sensor configured to monitor a phase of the AC power and generate the zero-cross interrupt upon detecting a change in phase from one of positive to negative and negative to positive.

[c8] 8.The system of claim 1 wherein the desired DC power includes a desired high voltage that is substantially greater than a rated operational voltage of a plurality of engine components.

[c9] 9.The system of claim 8 wherein the desired high voltage is at least 55 volts.

[c10] 10.The system of claim 1 wherein the at least one processor is further programmed to monitor a utilization of each of the plurality of windings and switch the electrical configuration of the plurality of windings such that each of the plurality of windings is utilized substantially pro-

portionally.

[c11] 11.The system of claim 1 wherein the switching alternator is incorporated into a recreational product.

[c12] 12.The system of claim 11 wherein the recreational product is one of an outboard motor, a water craft, an all-terrain vehicle, a motorcycle, a scooter, a snowmobile, and lawn equipment.

[c13] 13.A method of operating a switching regulator comprising:
receiving an AC power from a plurality of windings of an engine having a winding configuration;
determining an operating transition of the engine;
generating a signal corresponding to the operating transition; and
upon receiving the signal, switching the electrical configuration of the windings.

[c14] 14.The method of claim 13 further comprising:
regulating the AC power to deliver a DC power; and
operating a recreational product with the DC power.

[c15] 15.The method of claim 14 wherein determining an operating transition of the engine includes determining a switch point for switching the electrical configuration of the windings near a zero-crossing transition of a phase

of the AC power received.

[c16] 16.The method of claim 15 wherein zero-cross transition causes a creation of a zero-cross interrupt.

[c17] 17.The method of claim 13 further comprising switching the electrical configuration of the windings to at least one of a series configuration, a parallel configuration, and a combination series and parallel configuration.

[c18] 18.The method of claim 17 further comprising switching the electrical configuration of the windings to the series configuration at a first operational speed of the engine, to the combination of series and parallel configuration at a second operational speed of the engine, and to the parallel configuration at a third operational speed of the engine.

[c19] 19.The method of claim 18 wherein the second operational is greater than the first operational speed and the third operational speed is greater than the second operational speed.

[c20] 20.The method of claim 13 further comprising generating the AC power from a two-stroke engine.

[c21] 21.An outboard motor comprising:
a powerhead having a combustion engine configured to

drive a multi-mode alternator, a midsection configured for mounting the outboard motor to a watercraft, and a lower unit powered by the combustion engine to propel a watercraft;

a switching regulator configured to receive an AC power from a plurality of windings of the multi-mode alternator and deliver an operational DC power; and

an engine control unit (ECU) configured to control the switching regulator according to a first operation scheme upon receiving a first interrupt and a second operation scheme upon receiving a second interrupt.

[c22] 22.The outboard motor of claim 21 wherein the first operation scheme includes a first configuration of the plurality of windings and the second operation scheme includes a second configuration of the plurality of windings.

[c23] 23.The outboard motor of claim 21 wherein the ECU is selectively configurable to control the switching regulator according to at least one of a configuration of the outboard motor and a set of environmental parameters.

[c24] 24.The outboard motor of claim 21 wherein the first interrupt is a zero-cross interrupt and the second interrupt is a voltage regulation interrupt.

[c25] 25.The outboard motor of claim 21 wherein the ECU is further configured to determine at least one of a phase of the AC power generated by the combustion engine, a number of phase transitions of the AC power generated by the combustion engine, a winding load on each of the plurality of windings, and a revolutions per minute (RPM) of the combustion engine.